Grupa Lotos S.A.	**TECHNICAL SPECIFICATION**	Spec. nr: 3811
	Method of choosing the fire monitoring apparatuses	

Contents

1 Subject of the specification 2
2 Scope of Binding Force 2
2.1 Variations 2
3 Hierarchy of documents 2
4 Definitions and denotations 2
5 Ambient conditions 3
5 Description 3
5.1 General criteria of selection of the fire monitoring equipment and installation areas for LOTOS Group S.A.. 3
5.2 Objects requiring use of the fire detecting and signalling systems 4
5.3 Criteria of selection the objects, apparatuses, technical equipment and external areas assigned for fire monitoring 4
6 Principles of selection of the equipment or manufacturing areas for fire monitoring 7
6.1 Criteria of fire hazard assessment: 7
6.2 Method of selection of the apparatuses or manufacturing areas for fire monitoring 8
6.3 Assessment of probability of unsealing occurrence that can be reason of fire 9
6.4 Risk evaluation 11
7 Relevant Documents 11
8 Standards and Regulations 11
8.1 Construction Law 12
8.2 Firefighting Protection 12
8.3 Certifications and Admissions 12
8.4 Standards and Regulations 12
9 Enclosures 13
10 Record of changes 14

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1 Subject of the specification

The specification applicable with other technical specifications of Groupa LOTOS S.A. (GLSA) determine minimum requirements concerning selection of fire monitoring equipment, mounted in production installations.

2 Scope of Binding Force

This specification is applicable when offer requests and contracts are made for new planned investments and modernization projects as well as for the purposes of technical documentation of fire signalling for technical systems for LOTOS Group S.A. installations.

It also constitutes the basis for elaboration of detailed specifications and offer requests for individual and package deliveries.

2.1 Variations

Any deviation from this specification and the relevant specifications, standards and related documents including proposals, which the bidder claims to be economically and / or technically superior solutions, must be submitted in writing for review and approval by Grupa LOTOS SA. Non-approved exceptions are not acceptable by Grupa Lotos S.A.

The supplier must report in writing any ambiguity in this or any other specifications of Grupa LOTOS SA or non-compliance with the referred documents / standards and obtain a written explanation from Grupa Lotos SA.

3 Hierarchy of documents

In case of conflicts existing between this specification and other documents, the following order of precedence shall govern:

- The current Polish legislation
- Terms of purchase order / contract and other requirements agreed in writing with GLSA
- Data Sheets approved by GLSA
- This specification
- Other Specifications
- Drawings and other documents
- Standards

4 Definitions and denotations

GLSA – Grupa Lotos S. A.

BLEVE – Boiling Liquid Expanding Vapour Explosion

VCE – Vapour Cloud Explosions

5 Ambient conditions

- Ambient temperature (max/min) +36°C/-25°C
- Average monthly humidity (min/max) 70%/90%
- Elevation above sea level 1m
- Wind speed 26 m/s
- Snowfall 290 mm
- Atmosphere typical for refinery Grupa Lotos S. A. (marine, aggressive industrial, chemical and dusty)

5 Description

5.1 General criteria of selection of the fire monitoring equipment and installation areas for LOTOS Group S.A..

The main tasks of fire hazard detection systems are:

- early and effective hazard detection
- warning the personnel present in a hazard region of danger
- limitation of potential damage and range of fire by shortening the time between fire detection and beginning of effective action taken by the safety services
- limitation of possible harmful effects on the environment

Detection systems shall have the following features:

- fast reaction
- high operation reliability
- possible widest extent and detection zone
- maximum resistance to false signals, such as: solar radiation, atmospheric and electrostatic discharges, electrical welding, IR radiation, e.g. from heated up parts
- resistance to external conditions, high and low temperatures, humidity, snow, ice, condensation, occurrence of corrosives
- suitable explosion-proof class of devices, adapted to places of application or installation

5.2 Objects requiring use of the fire detecting and signalling systems

In the production installations of LOTOS Group S.A. fire monitoring system has to be applied in:

- technical buildings, i.e. stores and workshops where fire hazard occurs
- electrical stations – due to the possibility of voltage decay in the important technological nodes
- control rooms – to ensure a continual process control
- dedicated apparatuses, technological devices and pipelines constituting a potential source of fire

Further analysis, being a specific subject of the standard, refers to the equipment, technological devices and pipelines present on the production installations /units. The analysis presented below shall cover all objects present in a given production installation. Any doubts shall be explained by the Head of the installation /unit.

5.3 Criteria of selection the objects, apparatuses, technical equipment and external areas assigned for fire monitoring

The analysis first step is fire hazard's identification which is aimed to define all situations that pose a level of threat to the plant, its personnel and the environment.

It is possible to distinguish 3 types of hazard sources:

- internal, resulting from the type of technological processes carried out in the plant and technical solutions applied
- external, mainly resulting from extreme unfavourable weather conditions
- unintentional or purposeful factors, actions of unauthorized persons (e.g. terrorist attacks)

External hazard sources, unintentional or purposeful actions are not in the scope of this analysis.

Generally, internal hazards result from:

1. Deviation of the following assumed technological processes parameters:

- pressure
- mass flow
- change of state of concentration phase
- temperature

2. Damage of any coatings containing hazardous substances, such as:

- process/reactor tanks
- storage tanks of substances
- pipelines
- connections and sealing

3. Inefficiencies of pipelines and devices

- pumps,
- valves, cut-off devices
- control and measurement devices

4. Inefficiencies of supply systems:

- electric energy mains
- water system
- steam system
- air ducts

5. Human mistakes

- Operator's
- maintenance technician's

When classifying potential causes of fire hazard occurrence the following shall be predominantly taken into account

- system unsealing (puncturing)
- short circuits in electrical system
- human mistakes

Ruptures:

Ruptures are the most common cause of the fire.

In case of rupture substance release shall also be considered:

- release of inflammable fluid or inflammable gas from the so-called „hot" nodes, while the fluid or gas is at or above self-ignition temperature, results in most cases with self-ignition and stream fire. There are situations where self-ignition do not occur and where hot fluid or gas leakage creates a cloud that can be the source of fire or explosion. In such cases early detection of the imminent hazard shall be carried out by a flame detector.

- release of inflammable fluid or inflammable gas from the so-called „cold" nodes, while the fluid or gas is below self-ignition temperature, results in build-up of flammable vapour cloud (evaporation of liquid spills) which can be ignited by a source remote from the release point (e.g. a spark) and be secondary cause of an explosion or a fire. In such cases early detection of the hazard shall be carried out by an combustible gas detection.

Ruptures can lead to the hazards in the nodes as shown in below table.

Type of substance / installation/ operation	***Type of accident***							
				Explosion				
	Fires	***BLEVE***	***Violent fire***	***VCE***	***Dust***	***Others***	***Toxic gases***	***Toxic fumes***
Liquefied inflammable gases								
▪ pressure tanks	X	X	X	X				
▪ storage under atmospheric pressure	X		X	X				
▪ process installations	X	X	X	X				
▪ road/rail reloading places	X	X	X	X				
▪ road/rail transport	X	X	X	X				
▪ sea transport / operations on loading berths	X	X	X	X				
▪ industrial pipelines	X		X	X				
Inflammable fluids								
▪ storage tanks	X	X						
▪ process installations	X	X	X	X				
▪ road/rail reloading places	X							
▪ road/rail transport	X							
▪ sea transport / operations on loading berths	X							
▪ industrial pipelines	X							
Storage and processing								
▪ inflammable gas	X		X	X				
▪ inflammable powder substances	X				X			
▪ violently reacting substances	X			X	X	X		X
▪ toxic gases							X	
▪ substances with toxic burning products								X

Short-circuit in electrical installation:

Short-circuit in electrical installation can cause fire and shut-down of important technological units, control and measurement devices.

Short-circuit can cause a serious disturbances in the technological process and consequently can become an indirect reason of the fire hazard, therefore it is essential to monitor important technological process, electrical stations and cable rooms.

In the existing Grupa LOTOS S.A. areas and process units mentioned above are under supervision of fire alarm system.

Human error:

Human error is the most commonly occurring factor which contributes to the failure that can lead to the fire accidents.

Human errors shall be taken under consideration in case of manual operation (e.g. sampling) especially, due to the fact that technological processes are automatically controlled and equipped with alarm management and interlocking systems.

6 Principles of selection of the equipment or manufacturing areas for fire monitoring

6.1 Criteria of fire hazard assessment:

When systematizing the potential possibilities of fire hazard occurrence in a specific technological node, at the specific apparatus or device an assessment shall be carried out considering the following criteria:

- type of substance : flammable, inflammable, creating explosive mixtures or not
- operation parameters: pressure , temperature: higher or lower than self-ignition temperature of fluid or gases applied in the process
- importance of specific apparatus or device in technological process
- frequency and repeatability of failure in the analysed node
- applied design solutions concerning fire protection
- increased risk of human mistakes

Type of substance – analysis shall only cover inflammable substances creating explosive mixtures with air.

Operation parameters – the main analysed parameter is the medium temperature:

- temperature ≥ self-ignition temperature with possible unsealing in the analysed node is treated as a source of fire hazard; in this node fire monitoring is required

Importance of apparatuses and devices – in the analysis apparatuses and devices, that due to their special importance in technological process shall be monitored to limit the fault range and limit the results of possible fire

Frequency and repeatability of failure in analysed node – the nodes in which faults reoccur and pose fire hazard shall be analysed from the point of view of monitoring application.

Applied design solutions concerning fire protection – criterion enabling analysing the present monitoring devices from the point of view of their usability and effectiveness. In the scope of fire detecting and signalling the LOTOS Group S.A. specification is in force.

Possibility of human mistake shall be taken into account where manual operations are frequently carried out, e.g. at sampling, dewatering.

6.2 Method of selection of the apparatuses or manufacturing areas for fire monitoring

The analysis covers flammable substances and substances creating explosive mixtures with air only. The main analysed parameter is temperature of medium, temperature ≥ self-ignition temperature. In case of the unsealing it is treated as the source of fire hazard.
We propose to select the apparatuses with matrix method in the three gradual scale, by:

- assessment of the event influence
- assessment of event occurrence

Matching typical apparatuses or manufacturing areas with types of fire monitoring is shown in the table 1 (enclosure 1).

6.2.1 Assessment of force of event's results

Results	***Characteristics of the event***
Low harmfulness (1)	Insignificant for manufacturing continuity
Medium harmfulness (2)	Total or partial shut-down of installation
High harmfulness (3)	Hut-down of apparatus, device, technological node, Essential for maintaining operation continuity of other installations

Analysed event: unsealing, possibility of fire occurrence.

6.2.2 Assessment of probability of event's occurrence

Possibility	***Characteristics***
Lowly Probable (1)	from 1 ÷ 5 points according to the table 6.3
Moderately Probable (2)	from > 5 ÷ 9 points according to the table 6.3
Highly Probable (3)	obtaining > 9 points according to the table 6.3

6.3 Assessment of probability of unsealing occurrence that can be reason of fire

The assessment shall be performed according to the below score:

Item	***Reasons of possible unsealing***	***Number of points***		***Notes***
		Apparatuses	Machines	
1	2	3	4	5
1.	**Occurrence of violent changes of pressure or temperature during interlock shut-down of installation**			
1.1.	*occur*	3	3	
1.2.	*do not occur*	1	1	

1	2	3	4	5
2.	**Structure of machines**			
2.1.	*Type of Sealing*			
2.1.1.	double	-	1	
2.1.2.	single	-	2	
2.2.	*Monitoring of bearings temperature*			
2.2.1.	occurs	-	1	
2.2.2.	doesn't occur	-	2	
2.3.	*Monitoring of vibrations*			
2.3.1.	occur	-	1	
2.3.2.	doe not occur	-	2	
3.	**Human mistake** [1)] **– frequency of manual operations**			Sampling, opening of drain valves, dewatering
3.1.	*very often – once a day*	6	-	
3.2.	*Quite enough – once a month*	4	-	
3.3.	*rare - < than once a month*	3	-	
4.	**Location of an apparatus, machine**			
4.1.	*in the area of high building development*	3	3	
4.2.	*in the area of low building development*	1	1	
4.3.	*other factors*	1 ÷ 3	1 ÷ 3	
	TOTAL:	**Σ points**	**Σ points**	
5.	**Other protections**[2)] **(correction coefficient)**			
5.1.	*occur*	0,5	0,5	
5.2.	*do not occur*	1	1	
	TOTAL:	**Σ points x correction coefficient**		

Notes:

1. *High risk of human error occurrence* – such cases shall be assessed where a man can be a direct reason of unsealing– frequency of manual operations (sampling points, opening of drain valves, dewatering).
2. *Other protections* – application of devices for early hazard detection near analysed apparatus (hydrocarbons, hydrogen sulphide concentration sensors).

6.4 Risk evaluation

After above parameters are assessed the risk of event's occurrence will be evaluated with use of three gradual scale.

	EFFECT STRENGTH		
Possibility	***Low (1)***	***Medium (2)***	***High (3)***
Lowly Probable (1)	low	low	medium
Moderately Probable (2)	low	medium	high
Highly Probable (3)	medium	high	high

Conclusions:

6.4.1. Apparatuses, devices that achieved value *"high"* shall be provided with fire monitoring systems.

6.4.2. Apparatuses, devices that achieved value *"medium"* can be provided with fire monitoring systems.

6.4.3. Apparatuses, devices that achieved value *"low"* do not require fire monitoring systems.

Matching of estimated fire occurrence risk evaluation for devices of analysed installation shall be presented in a table – sample: table 2 (attachment 2).

7 Relevant Documents

Any "Technical Specification" issued by GRUPA LOTOS S.A. listed in Contract Files.

8 Standards and Regulations

It is in each case understood that quoted standards, regulations, directives and orders are of their latest editions, along with amendments, annexes and supplements in force.

8.1 Construction Law

- An Act of 07 July 1994. – Constructional Law. Unified text (Journal of Laws 2000.106.1126) as amended
- Regulation of the Minister for Infrastructure of 12.04.2002, concerning technical conditions with that buildings and their location should comply. Journal of Laws 2002.75.690.

8.2 Firefighting Protection

- An Act of 24.08.1991 on fire protection. Unified text Journal of Laws 2002.75.690.
- Regulation of Minister for Internal Affairs and Administration of 07.06.2010 on fire protection of buildings, other construction objects and sites. Journal of Laws 2010.109.719.
- Regulation of Minister for Internal Affairs and Administration on 16.06.2003 concerning approval of construction projects from fire protection point of view. Journal of Laws 2003.121.1137 as amended.

8.3 Certifications and Admissions

- The act on 30 August 2002 y. about conformity evaluation system. (JoL 2002.166.1360) as amended.
- Regulation of the Minister of Economy of 21 August 2007 on basic requirements for electrical devices (Journal of Laws, 2007.155.1089).
- The Law of 13 April 2007 on electromagnetic compatibility (JoL 2007.82.556).
- Regulation of Minister for Economy of 22 December 2005 on the basic requirements for safety devices and systems designed for application in explosion hazard zones (Journal of Laws, 2005. 263. 2203).
- Regulation of the Minister for Infrastructure of 15 April 2004 on conditions and procedure of conformity evaluation of telecommunication terminals designed for connection to public network and radio equipment terminations with essential requirements and way of their marking (Journal of Laws, 2004.73.659) as amended.
- The act of 16 April 2005 on building products (Journal of Laws 2004.92.881) as amended.
- Regulation of Minister of Economy of 21 November 2005 on technical conditions that the terminals and liquid fuel stations, long distance pipelines for crude oil transportation have to comply with and their location (Journal of Laws 2005.243.2063) as amended.

8.4 Standards and Regulations

- PN-EN 54-1 Fire signalling systems. Introduction.
- PN-EN 54-2 Fire signalling systems. Part 2: Fire signalling control rooms.
- PN-EN 54-5 Fire signalling systems. Part 5: Heat detectors. Point detectors.

- PN-EN 54-7 Fire signalling systems. Part 7: Fume detectors. Point detectors operating with use of dissipated light, penetrating light or ionization.
- PN-EN 54-10 Fire signalling systems. Part 10: Flame detectors. Point detectors.
- PN-EN 54-11 Fire signalling systems. Part 11: Manual fire warning.
- PN-EN 54-12 Fire signalling systems. Part 12: Fume detectors. Line detectors operating with use of penetrating light beam.
- PN-EN 54-13 Fire signalling systems. Part 13: Evaluation of component's compatibility.
- PKN-CENTIS 54-14 titled „Fire signalling systems – Part 14: planning, design, installation, commissioning, operation and maintenance guidelines"
- PN-ISO 6790 Equipment and devices for fire-protection and fire-fighting. Graphical symbols on fire-protection schemes.
- The law about fire-protection on 24 August 1991. (Journal of Laws 1991.81.351 as amended)
- Regulation of Minister for Economy on 21.11.2005 concerning technical conditions, with that the bases and liquid fuel stations, long distance pipelines for crude oil transportation have to comply and location of them (Journal of Laws No. 2005.243.2063 as amended)
- Regulation of Minister for Infrastructure on 12.04.2002 concerning technical conditions, with that buildings and their locations have to comply (Journal of Laws No. 2002.75.690 as amended)
- Regulation of Minister for Internal Affairs and Administration on 07 June 2010. concerning fire-protection of buildings, other construction objects and sites (Journal of Laws No. 2010.109.719)
- Regulation of Minister for Internal Affairs and Administration on 20.06.2007. concerning specification of products provided for assurance of public security or health and life protection as well as property protection and also principles of acceptance of the products for use (Journal of Laws 2007.143.1002)
- Guide for risk assessment methods concerning danger process installations – Authors: Mieczysław Borysewicz, Andrzej Furtek, Sławomir Potemski – Instytut Energii Atomowej – 2000.
- Basic Principles of Design the Fire Signalling Installations – CNBOP
- General Principles of Firefighting Devices Control – by Janusz Sawicki – CNBOP
- Requirements for cable network for fire-fighting devices according to standards and regulations - Janusz Sawicki – CNBOP

9 Enclosures

Enclosure no. 1

Table for choosing the fire monitoring apparatuses and devices /installation 500/

Enclosure no. 2

Table for fire hazard risk assessment /installation 500/

10 Record of changes

Item	Date	Description	Introduced by
1	30-11-2013 (rev. 1)	Review, update, standardize and changes to the Standard within scope of order No. OK/990/2012	Editorial board coordinated by T.Wróbel
-	31-08-2015	Page layout corrections, no contents changes.	T.Wróbel

LOTOS GRUPA	ENCLOSURE NR 1	Spec. nr: 3811
	Table for choosing the fire monitoring apparatuses	

Item.	*Technological number*	*Apparatus name*	*Medium name*	*Maximum operational parameters*		*Initial criterion qualifying apparatus for monitoring*	*Notes*
				pressure [bar]	*temperature [^{O}C]*		
1.	0500-E1A/B/C/D	exchanger	hydrocarbons + hydrogen	46.7	410	operation temperature >self ignition temperature	monitoring of group of apparatuses
2.	0500-E3A/B	exchanger	hydrocarbons + hydrogen	10.9	286		
3.	0500-E21A/B	exchanger	fuel oil	11	223		
4.	0500-V02	tank	oil + hydrogen	28	305	operation temperature >self ignition temperature	monitoring of group of apparatuses
5.	0500-E22A/B	exchanger	hydrogen, H_2S hydrocarbons	41	305		
6.	0500-P2A/B	pump	hydrocarbons	10	330	operation temperature >self ignition temperature	common monitoring
7.	0500-P3	pump	hydrocarbons	6	330		
8.	0500-C01	column	hydrocarbons + hydrogen gas	1.15	249/330	operation temperature >self ignition temperature	after initial confirmation by user resignation from monitoring
9.	0500-R0	reactor	fuel oil, hydrogen gas	31	385		
10.	0500-R01	reactor	hydrocarbons + hydrogen gas	31	385		

ENCLOSURE NR 2

Table for fire hazard risk assessment

Spec. nr: 3811

FIRE HAZARD RISK ASSESSMENT

Item	TECHNOLOGICAL NUMBER OF APPARATUS OR MACHINE	PROBABILITY OF UNSEALING OCCURRENCE																ESTIMATION OF PROBABILITY OF EVENT OCCURANCE	ESTIMATION OF FORCE OF EVENT RESULTS	RISK ASSESMENT	NECESSITY OF MONITORING [YES / NO]	NOTES	NR OF GROUP OF APPARATUSES DESIGNED FOR MONITORING ON RAFINERY LAYOUT
		OCCURRENCE OF VIOLENT CHANGES OF PRESSURE AND TEMP. DURING INTERLOCK SHUT-DOWN OF INSTALLATION		STRUCTURE OF MACHINES						HUMAN MISTAKE – FREQUENCY OF MANUAL OPERATION			LOCATION OF APPARATUS / MACHINE		OTHER FACTORS	OTHER PROTECTIONS (CORRECTING COEFFICIENT)		SUM OF POINTS S=Σ[1÷16]* Σ[1÷16]					
				TYPE OF SEALING		BEARING TEMPERATURE MONITORING		VIBRATIONS MONITORING																
		OCCURS	DOESN'T OCCUR	SINGLE	DOUBLE	OCCURS	DOESN'T OCCUR	OCCURS	DOESN'T OCCUR	VERY OFTEN DAILY	OFTEN ENOUGH MONTHLY	RARE < MONTHLY	IN AREA OG HIGH BUILDING DEVELOPMENT	IN AREA OG LOW BUILDING DEVELOPMENT	ACCORDING TO USER EVALUATION	OCCURS	DOESN'T OCCUR						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
INSTALLATION 0500																								
1	500-E1A/B/C	3											3		2[7)]		1	8	2	3	high	yes		16
2	500-E3A/B																							
3	500-E21A/B																							
4	500-V2	3											3		2[7)]		1	8	2	3	yes	tak		17
5	500-E22A/B																							
6	500-P2A/B	3		2			2		2			3	3			0,5		7,5	2	3	high	yes		18
7	500-P3A/B																							

NOTES:

1) Monitoring of valves' group in the low column part
2) Closed building, no service
3) Group of big amount of valves
4) uncomfortable access for service
5) possible hydrogen ignitions
6) possibility of temperature increase at unsealing
7) most of events

*) depends on Customer decision